



## CHAPTER II PRELIMINARY DESIGN

### SECTION 2-01

### CONCEPTUAL STUDY

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**2-01.1 PURPOSE.** A conceptual study is used to coordinate department thinking on the improvements to be included in a project and to obtain approval as required. The approved study is then used as the basis for further design. A conceptual study is prepared for each project in the program. The format of the study is dependent on the proposed improvements.

A conceptual study consists of a written report in the format of a conceptual study letter, 3R conceptual study report or a 4R pavement rehabilitation analysis and conceptual study report or a location study/environmental report. Location study/environmental reports are discussed in [Section 2-06](#).

**2-01.2 CONCEPTUAL STUDY LETTER.** A conceptual study letter, using the format given in [Figure 2-01.1](#), is prepared by the district for projects of the following nature:

- Relatively small projects providing specific improvements such as signalization, lighting, signing, or minor geometric revisions.
- Projects such as bridge replacements on rural low volume roads where it is obvious that the only practical corridor location is the existing or adjacent to the existing corridor.
- Projects environmentally classified as categorical exclusions (CE).
- Projects pending classification as a categorical exclusion (CE2) must have the justification approved by the FHWA, which results in a CE determination, prior to preparation of the conceptual study letter. The CE2 form is available on the LAN. (If the CE2 is determined by the FHWA to be an EA, a location study/environmental report is required. See [Section 2-06](#).)

For projects such as signalization projects, the conceptual study and preliminary signal layout may be combined in one submittal. The conceptual study letter format is not used for 3R or 4R conceptual study reports.

There may be some CE or CE2 projects for which it is advisable to prepare a location study report rather than a conceptual study letter. This should be considered in the case of a highly controversial project, or one in which two or more alternatives is being considered that would have different impacts on the community, such as locating an interchange. This process is detailed in [Subsection 2-06.3 \(1\)](#). In this case, for a CE2 project, the location study report is prepared concurrently with the CE2 form to aid in the FHWA determination for a CE or an EA classification.

Approximately 2 months prior to preparing a conceptual study letter, the district sends a request for environmental services (RES) form to the Preliminary Studies Division requesting project scoping and early constraint identification. This form is available on the LAN. Preliminary scoping may have been completed in order to obtain a CE classification from a CE2, however, it is necessary to request more detailed scoping to complete the conceptual study letter.

The conceptual study letter describes the project location and proposed improvements, explains any variations from the approved program, and identifies existing and proposed features of simple bridge replacements or other minor road construction projects. In a few instances, a project that uses a conceptual study letter format will have alternates being considered. In this case, all alternates considered should be documented in the conceptual study letter in a manner similar to a location study report.

If the current estimated cost is different than the programmed cost, the difference is explained in the remarks section of the letter.

All environmental work completed prior to the conceptual study letter is summarized and included in the conceptual study letter. The conceptual study letter then discusses any unusual features or anticipated difficulties to be encountered with the project, such as known archaeological sites, historic bridges, wetlands, Section 4(f) or Section 6(f) lands, hazardous waste sites, or other environmental issues as provided by the Preliminary Studies Division. Current cost estimates, borrow information when required, and any other pertinent information to the project that is not covered elsewhere are also provided under the remarks section of the letter.

A location sketch, existing and proposed typical sections and other documents as necessary, are attached to show the proposed improvement.

Following the signature of the preparer, a section is included for the recommendations or comments of the district engineer. If necessary to add more detail, the district engineer's comments may be submitted with a separate letter. Following that, signature and date lines are included to indicate the district engineer's approval of the study.

Minimum design standards are given in [Figures 4-04.1 and 4-07.1](#). A Design Exception Information form, as discussed in [Subsection 2-01.8](#), must be submitted to the Design Division for approval.

Approval and submittal of the conceptual study letter is detailed in [Subsection 2-01.9](#)

**2-01.3 3R CONCEPTUAL STUDY REPORT.** A 3R conceptual study report form, as shown in [Figure 2-01.2](#), is prepared by the district for all non-freeway 3R projects (resurfacing, restoration and rehabilitation). All non-freeway 3R projects are designed to meet or exceed minimum design standards as given in [Figures 2-01.3 and 2-01.4](#) for rural highways and [Figure 2-01.5](#) for urban highways. The values shown in [Figure 2-01.5](#) apply to any portion of a 3R project located within the limits of a city or town. A Design Exception Information form, as discussed in [Subsection 2-01.8](#), must be submitted to the Design Division for approval.

Approval and submittal of the 3R conceptual study report are detailed in [Subsection 2-01.9](#).

**2-01.3 (1) PROJECT INFORMATION.** Any difference in the project information from that programmed is explained in the letter of transmittal.

**2-01.3 (2) TRAFFIC DATA.** The designer requests traffic data from the Office of Transportation Management Systems. The data needed is shown on [Figure 2-01.2](#).

**2-01.3 (3) PAVEMENT DATA.** The district recommends the rehabilitation method. Any difference in the proposed pavement or shoulder structure from that shown in [Section 6-04](#) and [Section 6-05](#) is explained in the letter of transmittal.

The Strategic Highway Research Program manual titled "Distress Identifications Manual for the Long-Term Pavement Performance Project" is used to describe the pavement distress. The cause of the distress, such as inadequate pavement structure or moisture related damage, is noted if known. An estimated amount of pavement repair is given (see [Subsection 6-05.4](#)). It should be noted that all pavement repairs must be doweled into adjoining pavement to be eligible for federal funds. Projects with thin or badly deteriorated pavement that will not support doweling of pavement repairs into the existing pavement within a reasonable distance from the distress being corrected should be identified. Badly deteriorated concrete pavement may need to be replaced in its entirety.

**2-01.3 (4) GEOMETRIC DATA.** The horizontal alignment, vertical alignment, and other features of the highway section are compared to adjoining sections. Any items within the clear zone are listed. The design exceptions reflect the minimum distance to objects in the clear zone.

**2-01.3 (5) ACCIDENT DATA AND SAFETY ENHANCEMENTS.** This data is obtained from the "Accident" mainframe computer program in ROSCOE. The calculation for the project accident rate is shown in [Subsection 2-01.5](#). The accident data is carefully analyzed by the designer. Any unusual circumstances are

noted and recommendations for correction are proposed. Safety enhancements such as guardrail or bridge modification, and pedestrian measures such as wheelchair ramps or pedestrian signals are also listed.

**2-01.3 (6) PROJECT COST DATA.** If the current estimated cost is different than the programmed cost, the difference is explained in the letter of transmittal.

**2-01.4 4R PAVEMENT REHABILITATION ANALYSIS AND CONCEPTUAL STUDY REPORT.** A 4R pavement rehabilitation analysis and conceptual study report form, as shown in [Figure 2-01.6](#), is prepared by the district for all interstate and freeway 4R projects (resurfacing, restoration, rehabilitation and reconstruction). Part I of the form is filled out and submitted to the Design Division in order to initiate the pavement rehabilitation analysis by the Materials Division. If only one pavement rehabilitation method seems appropriate or a method is preferred by the district, supporting information should be provided with Part I of the 4R report. The rehabilitation analysis by the Materials Division will not be conducted until the project is in the third year of the program, and is preferred to be conducted with the project is in the second year of the program. Once the rehabilitation analysis has been conducted and returned to the district, Part II of the form is completed. All 4R projects are designed to meet or exceed minimum design standards as given in [Figure 4-04.1](#). A Design Exception Information form, as discussed in [Subsection 2-01.8](#), must be submitted to the Design Division for approval. To facilitate the evaluation of the design exceptions, Parts I and II should be submitted with the Design Exception Information form. After the Design Division returns the approved exception form and Parts I and II to the district, the district should submit the 4R report, including Parts I and II, the division approved exceptions, the rehabilitation analysis, and all costs (paving and non-paving) directly to the FHWA for approval. A copy of the submittals should be sent to the Design Division. All of the information provided to the FHWA should reflect the recommended rehabilitation alternate.

Approval and submittal of the 4R pavement rehabilitation analysis and conceptual study report is detailed in [Subsection 2-01.9](#).

**2-01.4 (1) PROJECT INFORMATION.** Any difference in the project information from that programmed is explained in the letter of transmittal.

**2-01.4 (2) TRAFFIC DATA.** The designer requests traffic data from the Office of Transportation Management Systems. The data needed is shown on [Figure 2-01.6](#).

**2-01.4 (3) EXISTING PAVEMENT DATA.** The Strategic Highway Research Program manual titled "Distress Identifications Manual for the Long-Term Pavement Performance Project" is used to describe the pavement distress. The cause of the distress, such as inadequate pavement structure or moisture related damage, is noted if known. An estimated amount of pavement repair is given (see [Subsection 6-05.4](#)). It should be noted that all pavement repairs must be doweled into adjoining pavement to be eligible for federal funds. Projects with thin or badly deteriorated pavement that will not support doweling of pavement repairs into the existing pavement within a reasonable distance from the distress being corrected should be identified. Badly deteriorated concrete pavement may need to be replaced in its entirety.

Any items which might restrict the addition of pavement thickness to the existing roadway are noted. These might include drainage structures, curbing, median barriers, right of way restrictions, or other special conditions.

The straight line profile identifies the location of all bridges, including overpasses, by log mile and station, and indicates at each location the field measured vertical clearances. It also states if the bridge is to be used in place, rehabilitated or reconstructed. [Figure 2-01.7](#) gives an example of a straight line profile.

An example of a sketch showing existing lanes, additional lanes proposed under the project, and additional lanes programmed in the future is shown in [Figure 2-01.8](#). The width of the median and location of existing bridges, including overpasses, is also shown on this sketch. The location of each item is identified by log mile.

- 2-01.4 (4) PROPOSED PAVEMENT DATA.** The proposed pavement data is submitted by the district after the rehabilitation method has been determined by the Materials Division. If the proposed pavement rehabilitation method is different than the one recommended by the Materials Division, justification must be provided.
- 2-01.4 (5) GEOMETRIC DATA.** The horizontal alignment, vertical alignment, and other features of the highway section are compared to adjoining sections. Any items within the clear zone are listed. The design exceptions reflect the minimum distance to objects in the clear zone.
- 2-01.4 (6) ACCIDENT DATA AND SAFETY ENHANCEMENTS.** This data is obtained from the "Accident" computer program in ROSCOE. The calculation for the project accident rate is shown in [Subsection 2-01.5](#). The accident data included in Part II is used to determine whether a special surface needs to be applied to reduce the accident rate. The accident data is carefully analyzed by the designer. Any unusual circumstances are noted and recommendations for correction made. Safety enhancements such as guardrail or bridge modification, and pedestrian measures such as wheelchair ramps or pedestrian signals are also listed.
- 2-01.4 (7) PROJECT COST DATA.** If the current estimated cost is different than the programmed cost, the difference is explained in the letter of transmittal.
- 2-01.5 ACCIDENT RATE CALCULATION.** An accident rate is calculated for each project and included in the conceptual study.

The formula for the accident rate is as follows:

$$\text{accident rate} = \frac{\text{no. of accidents} \times 100,000,000}{\text{no. of yrs.} \times 365 \times \text{ave. ADT} \times \text{length in miles}}$$

$$\begin{array}{l} \text{accident rate} \\ \text{(5 year)} \end{array} = \frac{\text{5 yr. total accidents} \times 54,794.52}{\text{ave. ADT} \times \text{length in miles}}$$

The accident rate yields a result in accidents per hundred million vehicle miles traveled (HMVMT). The number of accidents is the total number of accidents in the study period. For conceptual reports a five year study period is used, utilizing the last five full years of traffic accidents. It is acceptable to use the average ADT obtained by averaging the four year volumes from Supersession application TR50 as equal to the five year average ADT. The calculated accident rate is compared to the five year average statewide rate for a similar class of highway as found in the Maintenance and Traffic Annual Accident Report.

- 2-01.6 BASIC LIGHTING.** Basic lighting is provided along the major road at any interchange within the limits of a 3R or 4R project that meets the warrants given in [Section 8-01](#). If warranted, basic lighting is shown as part of the scope of the project and included on the Project Initialization / Estimate Form.
- 2-01.7 GUARDRAIL.** On all interstate and on any National Highway System roadway with an ADT of 6000 or more and a posted speed limit of 50 mph or more, all guardrail turned-down ends, concrete height transitions, and non-standard Breakaway Cable Terminals (BCT) within the limits of a 3R or 4R project are to be upgraded with an approved crashworthy end terminal. A non-standard BCT is defined as one that is not properly flared or the required recovery zone behind the BCT has not been provided as shown in [Figure 2-01.9](#).
- If the BCT meets the criteria in [Figure 2-01.9](#) and no work is required to the attached guardrail, the BCT may remain as is. However, if any part of the attached guardrail requires work, the BCT shall be replaced with an approved crashworthy end terminal, as shown on [Standard Plan 606.00](#).
- 2-01.8 DOCUMENTATION OF DESIGN EXCEPTIONS.** Documentation of design exceptions is necessary for the department to be able to defend itself from litigation. Litigation may take place many years after the actual construction and permanent documentation is necessary to determine the justification for design exceptions.

Design exceptions consist of items which vary from the "Policy, Procedure, and Design Manual", the "Policy on Geometric Design of Highways and Streets" (AASHTO Green Book), the "Roadside Design Guide", or other accepted guides.

The request for roadway design exceptions must be initiated and signed by the project manager in charge of the project. If the project is being designed by a consultant, the consultant's project manager should initiate the request and sign the design exceptions form first. All consultant design exceptions are reviewed by the district and signed by the district's project manager prior to submittal to the Design Division. The Bridge Division is responsible for furnishing all bridge-related design exceptions to the Design Division for processing.

Requests for design exceptions are made as the need arises; specifically at submittal of the conceptual study, preliminary plan, right of way certification, and plans, specifications, and estimate (PS&E).

The Design Exception Information form shown in [Figure 2-01.10](#) is used to request design exceptions. Additional supplemental sheets may be attached as needed. Whenever minimum design standards cannot be met, data for only those substandard items is listed. This data includes the existing feature (if applicable), the minimum design standard for that feature, the proposed feature, and the location of that feature. The column shown for existing features is not applicable to new construction. The appropriate values for minimum design standards are shown in the second column. The design standards for new construction and 4R projects are given in General Design Data Notes ([Figure 4-04.1](#)). The minimum rural design standards for 3R projects are given in [Figures 2-01.3](#) and [2-01.4](#), and the minimum urban design standards for 3R projects are given in [Figure 2-01.5](#). On urban projects, turning lane width and whether the pavement is curbed or uncurbed is noted on this form. A Design Exception Information form is not required if all minimum design standards are met.

All requests must contain reasons to justify the exceptions. It is imperative that the justification be sufficiently complete to clearly reflect that reasonable care was exercised by the designer in the selection of a particular highway design. It should be kept in mind when writing the justification that design exceptions arise because it is impractical or impossible to reasonably meet a specific design standard. If the standard can be reasonably met, then the item in question should be built to standard. The justification may include appropriate economic analysis, discussion of applicable accident location and type or discussion of avoidance of Section 4(f) or Section 6(f) lands. The justification should support the concept that maximum service and safety benefits were realized for the cost invested. Engineering judgement should be used when balancing the economic and engineering reasons for the justification. A design exception is based on sound engineering judgement rather than an attempt to save cost.

All requests are submitted to the Design Division, where the field liaison engineer reviews and forwards them to the Design Division Engineer. After approval by the Design Division Engineer, the field liaison engineer notifies the district and/or the Bridge Division. Design exceptions on interstate, major bridge and other special projects are required to be approved by the FHWA. Design Division will submit the approved design exceptions to the FHWA when required.

Changes in project scope, design criteria, standards, or general design policy could result in changes to design exceptions previously submitted. In this case, an amended Design Exception Information form must be submitted to the Design Division for approval. The amended form should include all exceptions previously approved. The letter of transmittal indicates if prior design exception approval was given.

The Design Division maintains the design exceptions in a permanent project file. A copy of the form is also kept in the district file.

**2-01.9 CONCEPTUAL STUDY REPORT APPROVAL AND SUBMITTAL.** The district engineer has the authority to approve all project specific details as contained in the right of way and construction program for projects that meet the requirements to use a conceptual study letter, 3R conceptual study report or 4R conceptual study report. For projects requiring a location study/environmental report, the approval and submittal requirements are described in [Section 2-06](#). All "non-exempt" projects (interstate, major bridge or certain special projects) require federal oversight. For these projects, the conceptual study report is required to be submitted to and approved by the

FHWA. The district should submit the conceptual study report directly to the FHWA for approval. The district should provide the Design Division and the Preliminary Studies Division a copy of the transmittal letter. The FHWA should provide both divisions with a copy of the approval letter.

For "exempt" projects (all other projects), the district engineer may approve the conceptual study report for these projects as long as design standards and policy established by the division are followed.

In both of these situations, the district will provide the Design Division and the Preliminary Studies Division with a copy of the approved conceptual study report.

**2-01.10 AIRPORTS.** If a highway improvement is located within 3 kilometers (2 miles) of an existing airport, a letter should be submitted to the Design Division as directed in [Subsection 2-03.8](#).